

GMI Tropospheric CTM

Some Current & Future Work

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At the May Meeting:

Future Work to Address Known Model Deficiencies

- 1) Latitudinal Distribution of CH₄ ✓
- 2) Aerosols : Heterogeneous Chemical & Radiative Effects
(In Progress)
- 3) Diagnostics (Emissions, etc.) ✓
- 4) Lightning (In Progress)

Some Modifications – Addressing Known Deficiencies

J. Kouatchou

Modified/Added Model Diagnostics

- 1) Save out specific constituents to wet/dry deposition & surface emission diagnostics, as opposed to all 86.
- 2) “Un-hardwired” noon_species diagnostic.
- 3) Tendencies: 2-D to 3-D (needs evaluation)
- 4) Effort to reduce file sizes : Save only trop layers, etc.
- 5) CO (monoterpenes & methanol); NO_x (NODOZ & Soils)

B. Das

Dry Deposition : Now deposit PMN, PPN, R4N2, N₂O₅ too.

CH₄ : Function of latitude

Transport : 35 constituents instead of 80

More Necessary Modifications

C. Readinger

KMG (from LLNL; generates chemical code)

Beginning Constituent Budget Calculations

Nitrogen Budget (Tg N)

Emission Sources (44.8 Tg N)

Aircraft	0.46 Tg N (1%)
Lightning	5.0 Tg N (11%)
Biofuels	2.2 Tg N (5%)
Fossil Fuels	23.6 Tg N (53%)
Biomass Burning	6.5 Tg N (15%)
Nodoz	0.5 Tg N (1% ??)**
Soils	6.6 Tg N (15% ??)**

** Still need to add diagnostics to know exact emissions.

Sinks (49.7 Tg N)

Wet Deposition : HNO_3 (28 Tg N)

Dry Deposition : (22 Tg N)

NO_2 (1.6 Tg N)

HNO_3 (18.5 Tg N)

PAN (0.5 Tg N)

$\text{N}_2\text{O}_5 + \text{PMN} + \text{PPN} + \text{R}_4\text{N}_2$ (0.2 Tg N)

Current/Recent Modifications

M. Bhat

Lightning Parameterization : Dale Allen & Ken Pickering

J. Kouatchou

Aerosols : Heterogeneous Chemical & Radiative Effects
following Chin et al. [2002] & Martin et al. [2003]

Fast-JX (12 bins) : Currently using FAST-J (7 bins).
Problems : HC cross-sections?
Aerosols?

New Meteorological Fields**

- GEOS-4-AGCM [GMAO; GMI request]
- GEOS-4-DAS [GMAO; GMI request]
- GEOS-4-Forecast [GMAO; GMI request]
- Oslo/EC-Forecast [Oslo U./UCI, M. Prather]

***Please Use these Names to Reduce Confusion!*

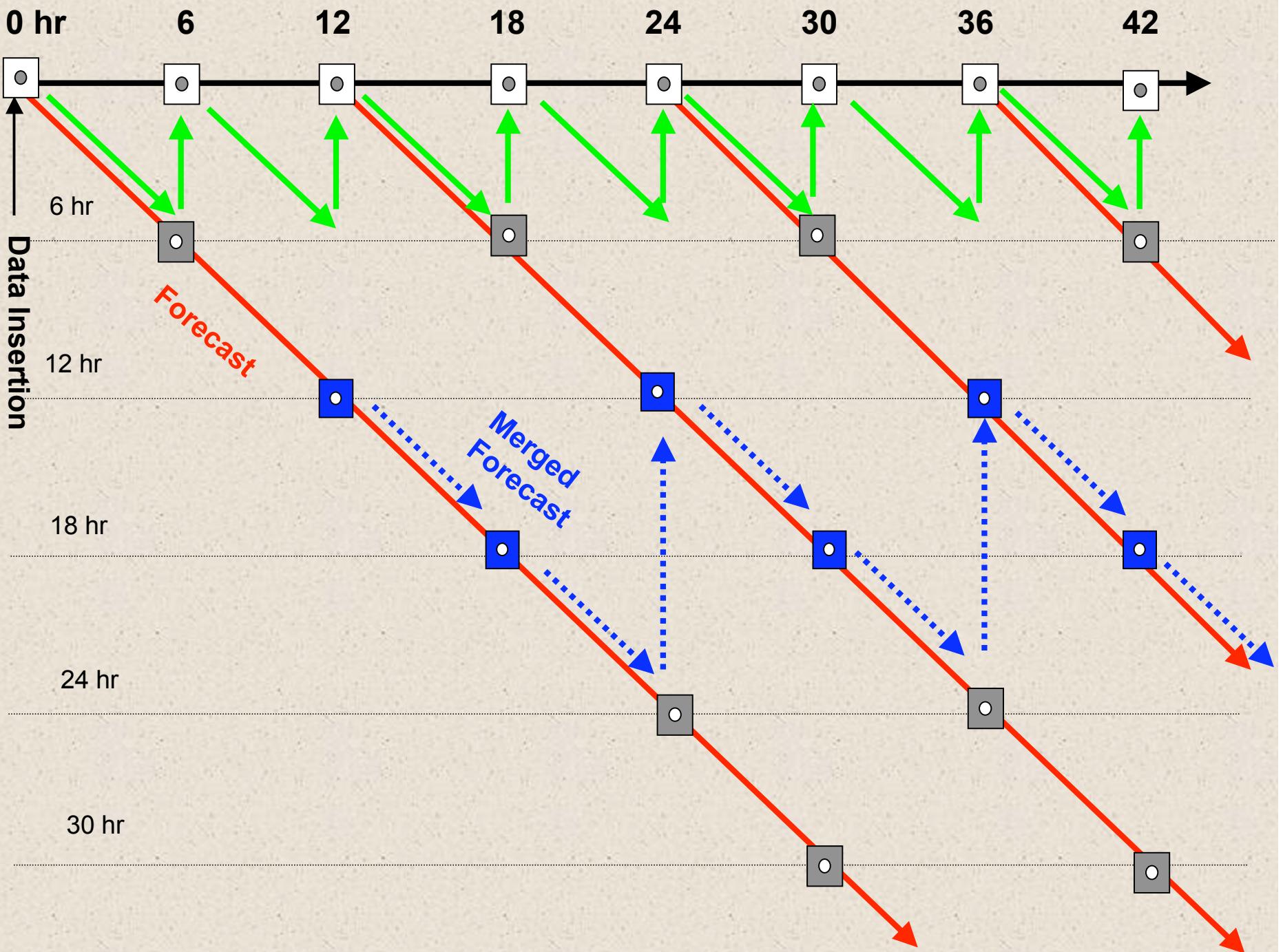
Why forecast fields?

Data insertions in assimilation process cause “Data Shocks” :

Non-physical forcings/
Perturbations to the balance of the GCM's
governing equations of motion

which lead to unrealistic transport in a CTM (e.g.,
Excessive STE).

Forecast fields keep info from assimilation, but
partially damp the effects of data insertions.



Forecast Issues

How do we chose the optimal merge of forecasts?

distance from “data shock”

vs

accuracy of forecast

vs

“forecast shock”

Met Field Details

GEOS-4-AGCM

- 5 years (SST 1994-1998 2xENSO)
- 42 eta layers to 0.01 hPa (originally 55 layers)
- 2° latitude x 2.5 ° longitude (regridded)
- Eric Nielsen (GMAO)

- 1) Credible STE & Stratospheric Circulation
- 2) Evaluate credibility of interannual variation.
Data Sets?
- 3) Evaluate tropospheric circulation.
- 4) GCM “baseline” simulation.

Met Field Details

GEOS-4-DAS

- Currently Available (GMAO) : ~2000?-present (several versions & GEOS-5 next)
- Jan-Apr 2001 (GEOS-4, v4.03 CERES)
- 42 eta layers to 0.01 hPa (originally 55 layers)
- 2° latitude x 2.5 ° longitude (regridded)

- 1) Excessive STE & Inter-Hemispheric Transport
- 2) Simulate Trace-P period.

Met Field Details

GEOS-4-Forecast

- Jan-Apr 2001
- 42 eta layers to 0.01 hPa (originally 55 layers)
- 2° latitude x 2.5° longitude (regridded)
- Hiroo Hayashi (GMAO)

- 1) Excessive STE & Inter-Hemispheric Transport?
- 2) Simulate Trace-P period.
- 3) Produce more fields in future?

Met Field Details

Oslo/EC-Forecast

- T159 L40
 - Not directly related to ERA-40 fields from ECMWF
 - Jan-Apr 2001 + a few full years
 - 37-40 vertical layers; top layer >20 hPa
 - will be regridded to 2° latitude x 2.5° longitude
 - Oslo University/UCI
- 1) Low model top, so fields limited for COMBO model;
will need Synoz or Linoz.
- 2) Simulate Trace-P period.

Evaluation of Transport

- STE:
 - 1) Mark Olsen's trajectory technique
 - 2) ^7Be
 - 3) T & constituent concentrations
(e.g., HALOE, EOS MLS)
- Stratosphere: Anne D., Susan S., et al.
- Inter-Hemispheric Transport in Troposphere: 1)
 ^{85}Kr ?; 2) CFCs/HFCs/HCFCs
- Convection: ^{222}Rn & ^{210}Pb
- Plume Transport: Trace-P Asian plumes
- Any Other Ideas?